technology currently available today is GR-303. The need to make minor modifications to OSS to allow for electronic ordering of unbundled GR-303 loops does not mean this technology is not available. Minor modifications are often needed to deploy any technology. The requirement that technology be currently available simply means that the technology must be one that a new entrant would choose if it were constructing a network today. There is no doubt that a new entrant would choose GR-303 and would work with vendors to eliminate any minor OSS or security issues that might initially hinder the most efficient use of GR-303 technology.

Finally, it is important to note that Verizon does not even state what amount of UDLC it believes is appropriate for use in the Synthesis Model. In its rebuttal testimony, Verizon simply argues that GR-303 cannot be used for 100% of fiber-fed loops because of technical issues associated with unbundling and non-switched services in a multi-carrier environment. Verizon Exh. 109 (Murphy Reb.) at 26-27.[130] But Verizon does not propose any modification to the Synthesis Model as a result. Certainly, it would be inappropriate to substitute the input from Verizon's models. Verizon proposes a mix of UDLC and IDLC that reflects Verizon's installation over the *past* three years in its embedded network, which is intended to serve as a surrogate for the amount of UDLC and IDLC Verizon expects to deploy over the next three years. *Id.* at 25, 27. But this deployment resulted, at least in part, from the constraints of Verizon's embedded network. AT&T/WCOM Exh. 12P (AT&T/WorldCom Recurring Cost Panel Reb.) at 22-23. Verizon makes no effort to show that the **BEGIN VERIZON PROPRIETARY ***** ***** END VERIZON PROPRIETARY** UDLC it includes in its models is necessary to provide non-switched services or unbundled loops (even if such services could not be provided using GR-303). Verizon has not attempted to calculate how much UDLC would be needed for such purposes; it also has not compared the amount of UDLC deployed in

[130] Verizon does not even argue for use of any TR-008 in the Synthesis Model, as the only reason Verizon deployed TR-008 in its own models is the constraints of its own network.

Virginia with the amount deployed in other states, and it has not isolated new switches to determine the mix of UDLC, TR-008 and GR-303 deployed in those switches, which are less constrained by Verizon's existing network. Tr. 4149 (Gansert). In fact it is highly unlikely that the amount of UDLC proposed by Verizon for use in its own models would be needed even if UDLC were used to provide service for all relevant non-switched services and all relevant unbundled loops.[131] Verizon acknowledges that all non-switched services constitute at most 10% of the services in its network, Tr. 4160 (Gansert),[132] and Verizon presents no forecast suggesting that unbundled loops would take up the additional UDLC capability.[133] Thus, it cannot be presumed that the high level of UDLC that Verizon assumes in its own Model is appropriate for use in the Synthesis Model even if Verizon were correct that UDLC is required for non-switched services and for unbundling.

The mix of DLC technology advocated by Verizon for use in its own models is inappropriate even for these models. First, Verizon bases the amount of UDLC in its models on the amount it has deployed over the past three years and has even less justification for the

---

[131] At most, UDLC would be needed for non-switched services that require connection of copper to fiber; even Verizon does not claim UDLC is needed to connect copper to copper or fiber to fiber. Similarly, at most, UDLC would be needed for unbundled loops that are not part of UNE-P. Even Verizon does not claim that loops that do not have to be connected to a collocation cage require UDLC for unbundling.

[132] In any event, the cost of using UDLC for non-switched services should be attributed to the those services, not to a 2-wire or 4-wire analog loop. AT&T/COM Exh. 12P (AT&T/WorldCom Recurring Cost Panel Reb.) at 23.

[133] And even for these loops, there would be no need to transfer the loop to UDLC; instead, the UDLC capability of the IDLC system could be used. AT&T Ex. 122 (Telcordia Notes on the Network, Oct. 2000) at 12-54. Mr. Gansert acknowledges that unbundling could occur using the GR-303 operational capability through UDLC while avoiding all security concerns. Tr. 4176-84 (Gansert). Verizon's current deployment of UDLC is not an accurate estimate of the UDLC would be required for such a process. Currently, Verizon does not deploy significant amounts of GR-303 in Verizon East and thus does not use the method of unbundling described by Mr. Gansert.

amount of GR-303 in its models. Tr. 4154-59.[134] Verizon's own planning guidelines, including its 2000 planning guidelines, show that Verizon will deploy GR-303 in the future. Thus, Verizon cannot estimate the DLC mix it will deploy in the next three years from what it has deployed in the past. Second, the mix of DLC technologies Verizon will deploy over the next three years is largely determined by the constraints of Verizon's existing switches and by the fact that Verizon has decided not to deploy significant amounts of GR-303. But the modeling process assumes deployment of new switches, an increased use of fiber as opposed to copper, and deployment of large amounts of DLC all at once. This makes it difficult to determine how to evaluate the DLC mix that should be used in Verizon's models given the forward-looking model requirements. Tr. 4557 (Murray). But it is clear that CLECs should not be required to pay for all new switches and increased fiber and then be required to pay for a more expensive DLC mix that results from the constraints of Verizon's existing switches and incremental deployment of DLC technology. It makes far more sense to conclude that an ILEC using all new switches would adopt the most efficient DLC technology – GR-303 even within the constraints of Verizon's models.

b. DLC Input Values

The Synthesis Model uses a lower input for DLC hardware costs than was used by the Commission. Verizon disputes the use of the lower costs. Verizon Exh. 109 (Murphy Reb.) at 110. As Mr. Riolo explained at length, however, the DLC line card input values used in the Synthesis Model exceed those in a recent market forecast report prepared by the RHK company, and, even more important, the DLC input values as a whole exceed the DLC costs in Verizon's own purchasing contract with Litespan. AT&T/WCOM Exh. 6 (Riolo Dir.) at 13-36; AT&T/WCOM Exh. 18P (Riolo Surreb.) at 12-14.

[134] Verizon did not perform any optimization routine to determine the mix of fiber and copper or GR-303 versus TR-008. Tr. 3100-01, 3137-38.

c. Concentration of GR-303

One of the advantages of GR-303 is its ability to concentrate traffic so that more that one POTS line can be served over the same channel. AT&T/WCOM Exh. 12P (AT&T/WorldCom Recurring Cost Panel Reb.) at 30-31. **[BEGIN VERIZON PROPRIETARY]**

[END VERIZON PROPRIETARY]

In the Synthesis Model, AT&T and WorldCom did not change the 1:1 concentration ratio used by the FCC in its calculation of costs for universal service purposes. As a result, the Synthesis Model *overstates* costs.

d. EF&I Factors

Verizon applies Engineer, Furnish & Install ("EF&I") loadings to its digital loop carrier equipment costs. Thus, for example, Verizon increases the costs of plug-in equipment by [**BEGIN VERIZON PROPRIETARY**] [**END VERIZON PROPRIETARY**] to account for the cost of installation. But even Verizon acknowledges that the cost of installing plug-ins is very small. And Verizon's own data on EF&I show that the EF&I for plug-ins is [**BEGIN VERIZON PROPRIETARY**] [**END VERIZON PROPRIETARY**]. AT&T/WCOM Exh. 12P (AT&T/WorldCom Recurring Cost Panel Reb.) at 75. AT&T and WorldCom have therefore reduced the EF&I for plug-ins in restating Verizon's costs.

Verizon contends that if the EF&I for plug-ins is adjusted downwards, then other EF&I values must be adjusted upwards. Verizon Exh. 122 (Verizon Recurring Cost Panel Surreb.) at 56-57. But Verizon's overall value for EF&I appears incorrect. When Verizon finally provided its EF&I data, they showed that for basic equipment such as a deskjet color printer, **[BEGIN VERIZON PROPRIETARY]**

[END VERIZON PROPRIETARY]. The EF&I for other equipment appeared equally overstated. AT&T Ex. 133.

Verizon states that these mathematical anomalies are due to its method of accounting and argues that the EF&I factors for installation jobs as a whole are accurate. But there is no way of assessing this claim when all the individual values appear inaccurate. Given this evidence, the adjustment by AT&T and WorldCom is reasonable.

9. Utilization And Fill Factors

The Synthesis Model relies on target fill factors to provide spare capacity to account for maintenance, churn, demand fluctuation and some amount of growth. Significant additional spare capacity is built into the Synthesis Model because the target fill factors result in lower "effective fill" after taking into account the discrete sizes in which certain assets such as copper and fiber are available. AT&T/WCOM Exh. 14P (Pitkin Surreb.) at 13.

Verizon criticizes the fill factors in the Synthesis Model as inadequate to provide for maintenance, churn, demand fluctuation and growth without even determining the effective fill factors in the Model; Verizon Exh. 109 (Murphy Reb.) at 21-22; AT&T/WCOM Exh. 14P (Pitkin Surreb.) at 13 n. 14.[135] Verizon does not analyze individual fill factors or explain why these factors are inadequate to provide for maintenance, churn, demand fluctuation, and growth.

[135] The Synthesis Model also includes sufficient capacity to provide service to vacant locations because its customer locations are based in part on a database used for mass mailings, including vacant homes due to real estate turnover. AT&T/WCOM Exh. 14P (Pitkin Surreb.) at 42-43.

Verizon's proposed fill factors for its own models, cannot be imported into the Synthesis Model. Those fill factors are largely based on Verizon's purported experience in its existing network, after breakage has occurred. They are not target fill factors. Nor are these fill factors disaggregated by density zone, as would be required for use in the Synthesis Model. Tr. 4494-96 (Baranowski); *id.* (Gansert) ("It's really a totally different use of the utilization factor.")

Moreover, Verizon's fill factors, based on its embedded network, provide even more spare capacity for growth than the Synthesis Model fill factors. If there were more spare capacity in the Synthesis Model to account for growth, prices would also have to be based on the anticipated demand for that spare capacity. The Commission has explained the importance of consistent calculation of capacity and demand:

> [T]he synthesis model currently calculates the average cost per line by dividing the total cost of serving customer locations by the current number of lines. Because the current number of lines is used in this average cost calculation, we agree with AT&T and MCI that the total cost should be determined by using the current number of customer locations. As AT&T and MCI note, 'the key issue is the consistency of the numerator and denominator' in the average cost calculation.

Universal Service Tenth Order ¶ *56 (citation omitted).*

Verizon advocates adding additional capacity to the Synthesis Model through use of lower fill factors without spreading the cost of that capacity over additional demand. This would result in overrecovery of costs.[136] As the Commission explained, "[I]f we were to

---

Moreover, both this Commission and state commissions have determined that vacant units do not need to be included in cost studies. *Universal Service Tenth Order* ¶¶ 56-59 (noting importance in consistency in development of total lines and total cost and rejecting use of housing units instead of households in cost calculation). AT&T/WCOM Exh. 14P (Pitkin Surreb.) at 41-42.

[136] Consider a fictitious network consisting of 100 customers that is expected to last for 10 years. Feeder plant could serve those customers for $100,000, but the feeder plant could also be

calculate the cost of a network that would serve all potential customers, it would not be consistent to calculate the cost per line by using current customer demand. In other words, it would not be consistent to estimate the cost per line by dividing the total cost of serving all potential customers by the number of lines currently served." *Universal Service Tenth Order* ¶ 58. *Accord*, AT&T Exh. 100, A. Kahn, *The Economics of Regulation* at 121; *Local Competition Order* ¶ 682 (directing that fill factors reflect "the total cost of the element" divided by a "reasonable *projection* of the actual total usage of the element")

If additional capacity were built into the Synthesis Model and the cost of that capacity were spread over expected demand, the net result would be lower, not higher costs. The reason a carrier builds excess capacity for growth is that it is less expensive to construct that capacity today on a net present value basis than it would be to construct that capacity tomorrow, taking into account projected demand. AT&T and WorldCom have shown that if additional spare capacity were built into the Synthesis Model to serve additional years of projected demand, and the costs were spread over that demand, the cost per customer would actually decrease.[137]

---

constructed to serve 150 customers for only $120,000. If the company constructed the additional capacity later, the feeder plant would cost $150,000. Although it is less expensive to construct the additional capacity now, it only makes sense to construct the additional capacity now if the network is expected to grow so that the cost per customer of the feeder plant would be less over the 10 year period. If the company charges the customers more in year 1 because it has constructed capacity to serve 150 customers and continues to charge this amount over the 10 year life of the network, it will overrecover its costs. *See* AT&T/WCOM Exh. 20 (Murray Surreb.) at 39-40.

[137] The target fill factors in the Synthesis Model provide sufficient spare capacity to allow for at least three years of growth from 2001 to 2004, the period the Model will be in effect. The Model then determines the cost per customer by dividing by the expected customers for mid-year 2002, the mid-point in the planning period. If the Model instead included sufficient capacity for growth through 2006 but spread those costs over the customers who would use the capacity over the five year period, costs would actually be ten percent lower. AT&T/WCOM Exh. 14P (Pitkin Surreb.) at 16-17.

The fill factors proposed by Verizon for use in its own models are too low.[138] With important exceptions, Verizon bases the fill factors in its studies on the purported fill in its embedded network. But Verizon understates the fill in its embedded network, fails to show its proposed levels of fill are efficient, and, even more fundamentally, proposes significant spare capacity to provide for growth without reducing its costs to account for the increase in demand that will result from that growth.

Verizon's estimate of the utilization levels in its current network is dubious at best. Verizon claims that its utilization level for copper feeder is **BEGIN VERIZON PROPRIETARY *** *** END VERIZON PROPRIETARY.** During the hearings, however, Mr. White stated that he had conducted a survey of survey of 7% of the feeder routes in Virginia and found that the average feeder utilization was 80% . Tr. 4994-95, 5006-08 (White). Verizon's embedded fill also is likely lower than the fill that would exist in a reconstructed network. GTE planning documents reveal target fill factors far higher than Verizon suggests is appropriate. Moreover, Verizon's embedded network contains numerous feeder routes and other plant built to accommodate future growth that did not ultimately materialize – routes that would not exist in a reconstructed network, rendering Verizon's existing fill an inaccurate estimate of fill in a reconstructed network.

More fundamentally, when Verizon builds its real network it provides substantial spare capacity to allow for growth and presumes that growth will continue into the future. Tr. 2995 (Tardiff). When that growth occurs, some of the spare capacity that Verizon has

[138] Verizon applies utilization factors after calculating unit costs of network equipment. Thus, to determine distribution costs for a UAA with 1000 customers, Verizon picks a cable sized to the number of working lines, determines the unit cost, and then divides those costs by a utilization factor to arrive at the cost per customer. Tr. 4216-19 (Gansert). Thus, if Verizon's distribution utilization is 40%, Verizon will divide by 40% to arrive at a cost per customer because it presumes that 60% of the plant will be unused. Tr. 4221-22 (Gansert).

provided will be used up. Tr. 2995-96 (Tardiff); Tr. 4204-05 (Gansert). Yet Verizon's Model prices UNEs as if the level of spare capacity remains constant over time, as if demand does not increase. Verizon charges present customers for capacity that will be used by future customers and then *also* charges future customers for that capacity. AT&T/WCOM Exh. 11P (Murray Reb.) at 32 ("Verizon has modeled plant to meet future demand as well as current demand, but the company has calculated unit costs using only current demand in the denominator of the calculation.") In a competitive market, such a pricing strategy would be vulnerable to competitive entry by a firm that charged present customers for present demand only – or even by a firm that built a network with no spare capacity for growth and charged customers only for the capacity it had built.[139] Moreover, a firm "will not make the right investment decisions unless it bears the risk of recovering the carrying cost of today's spare capacity from future customers." AT&T/WCOM Exh. 20 (Murray Surreb.) at 39-40. If excess capacity is put into the model for growth because this minimizes the net present value of deploying the network over the life of the network, then the unit price should be based on the total demand over the life of the facility. Tr. 3212 (Murray); AT&T/WCOM Exh. 11P (Murray Reb.) at 33. Alternatively, "because such a calculation is a difficult one," a model can estimate cost by assuming capacity is not built for

[139] Verizon's experts were unable to assess whether it would be efficient for a firm that built spare capacity to assess all of those costs to current customers or whether such a firm would be vulnerable to entry from a competitor that did not charge current customers for such spare capacity. Tr. 2983-90 (Shelanski, Tardiff).

One BOC expert, however, has acknowledged that, at least as a matter of fairness, present customers should not have to pay for all of the spare capacity built for future customers: "We have already posed the question of the proper rate [of depreciation] when a plant is built far in advance of total need – perhaps because there are great economies of scale. To charge depreciation in equal annual installments would be to impose a disproportionately heavy burden on customers in earlier years, when much of the capacity lies idle. Considerations of fairness – the idle capacity is really for the benefit of future, not present customers – and economic efficiency present a case for something similar to SRMC pricing, which would have the effect of concentrating the capital charges in later years." AT&T Exh. 100, A. Kahn, *The Economics of Regulation* at 121.

growth and not accounting for the revenues that would result from utilization of that capacity. AT&T/WCOM Exh. 20 (Murray Surreb.) at 40; *Universal Service Tenth Order* ¶ 58 (refusing to include future demand because of the speculative nature of that demand.).

It is no answer to say, as Verizon repeatedly does, that the average fill factors in its network have remained constant over time. The capacity that Verizon accounts for in its pricing models would get used after it was built. The fact that Verizon simultaneously would build additional capacity to serve additional demand, thus keeping utilization levels in its network constant, is irrelevant because this additional capacity and demand is not modeled.

Verizon argues that some of the spare capacity in its embedded network is necessary for administration and maintenance and is not built to prepare for future growth. Verizon Exh. 122 (Verizon Recurring Cost Panel Surreb.) at 105. Spare capacity is also needed, according to Verizon, to meet Vriginia Commisison requirements so it can respond quickly and flexibly to service orders. *Id.* at 107-14 But Verizon nowhere even attempts to demonstrate that the fill factors proposed in AT&T/WorldCom's restatement of Verizon's models are insufficient to provide sufficient spare capacity for administration, maintenance, and response to service orders. A 60% fill for distribution plant, for example, provides substantial spare capacity to serve these purposes. Although Verizon suggests that any fill factor higher than that which exists in its embedded network would be insufficient to meet the requirements of the Virginia Commission, that very Commission adopted a fill factor of 50% for distribution plant in the prior Virginia UNE proceeding. AT&T/WCOM Exh. 12P (AT&T/WorldCom Recurring Cost Panel Reb.) at 44.

Finally, it is important to note that the fill factors used as inputs in Verizon's models not only deviate from sound economic principles, they also deviate from Verizon's own engineering definition of fill. Although Verizon calculates fill by dividing working pairs by all pairs, Verizon's engineers calculate fill by dividing working, idle dedicated, and defective plant. AT&T/WCOM Exh. 12P (AT&T/WorldCom Recurring Cost Panel Reb.) at 48-50. Thus, if a pure engineering definition were used, fill would also be substantially above that used by Verizon in its models for yet another reason.

a. Copper Distribution Cable in the Synthesis Model

The Synthesis Model uses the target fill factors for copper distribution adopted by the Commission as forward-looking in its USF proceeding. Verizon criticizes these fill factors but never sets forth what the effective fill factors should be. The Synthesis Model target fill factors for distribution cable are 50-75%, and the effective fill factor (averaged across density zones) is 52.5%. AT&T/WCOM Exh. 14P (Pitkin Surreb.) at 13-14. Although Verizon states that a network built using the Synthesis Model's distribution fill would have insufficient capacity to accommodate demand fluctuations and customer churn and does not account for facilities at vacant premises, Verizon Exh. 109 (Murphy Reb.) at 86, Verizon never states how much spare capacity is needed for these purposes and why the Synthesis Model's spare capacity is insufficient. The Virginia Commission obviously believed that distribution fill similar to that in the Synthesis Model was sufficient when it adopted a 50% fill in the first Virginia UNE proceeding. Moreover, as Mr. Riolo explained, he personally directed operations that had a fill factor in excess of the effective fill in the Synthesis Model, and, in examining Verizon's estimate cases for maintenance operations, found parts of Verizon's plant that operated above the effective fill in the Synthesis Model. Tr. 4514-15 (Riolo). Clearly that fill was sufficient to meet demand fluctuations and provide for customer churn.

With growth in demand in Verizon's network averaging 3% per year, an effective fill factor of 52.5% also provides substantial spare capacity to allow for growth of second lines and other growth in customer demand. *Cf. Universal Service Tenth Order* ¶ 201 ("Significantly, we note that, contrary to GTE's inference, current demand as we define it includes an amount of excess capacity to accommodate short-term growth."); *id.* ¶ 203 (rejecting Bell Atlantic's claim that fill factors should be lower because there was no evidence that such fill factors were insufficient to meet current demand plus some growth). Verizon argues that the Synthesis Model does not guarantee that at least one additional distribution pair is allocated to each subscriber location. Verizon Exh. 109 (Murphy Reb.) at 85. By providing almost one additional line for every working line, however, including every second and third line that is working, the Synthesis Model does provide, on average, more than two pairs per household. Verizon states that the average lines per household in Virginia is 1.18. Tr. 4192-93 (Gansert). With an effective fill factor of 52.5%, therefore, the Synthesis Model actually constructs an average of 2.25 lines per household.

As a result, the Synthesis Model substantially overstates the price of distribution plant. By constructing an average of 2.25 lines per household, the Model constructs sufficient capacity to serve many years of growth. But the Model does not cost that capacity by dividing all projected demand over the life of the loop plant. The Model costs distribution plant based on the demand projected for mid-year 2002, not the mid-point in the projected life of the plant constructed in the Synthesis Model.

b. Copper Distribution in Verizon's Model

Verizon also understates the distribution fill that should be used in its own models. Verizon bases its copper distribution fill factor on the fill levels it claims are currently experienced in its embedded network. Verizon asserts that this level is **[BEGIN VERIZON PROPRIETARY]** **[END VERIZON PROPRIETARY]**. This is undoubtedly not Verizon's actual fill, but even if it were, that fill factor would be entirely inappropriate as a basis of assessing cost.

In allocating costs, Verizon divides the costs of the loop plant in its models by the number of working lines and then divides the resulting number by the fill factor. The effect is to calculate costs as if Verizon constructed **[BEGIN VERIZON PROPRIETARY]**

[END VERIZON PROPRIETARY]

working pairs. AT&T/WCOM Exh. 12P (AT&T/WorldCom Recurring Cost Panel Reb.) at 44-45. This is far more than the two pairs per household called for by Verizon's Engineering Guidelines.

Moreover, Verizon does not establish that it is efficient to construct two pairs per household. Although Verizon claims this guideline has been universally used by ILECs for many years, **[BEGIN VERIZON PROPRIETARY]**

[END VERIZON PROPRIETARY]

In the many neighborhoods in which demand for second lines has remained stable and is likely to remain so going forward, there is no need to construct two distribution pairs per household. Far fewer distribution pairs could be built while still providing sufficient capacity to serve any demand for second lines that did arise. AT&T/WCOM Exh. 12P (AT&T/WorldCom Recurring Cost Panel Reb.) at 46-47. This is particularly so in a world in which the advent of DSL has reduced customers' need for second lines. *Cf. Universal Service Tenth Order* ¶ 200 (noting that ultimate demand may decrease substantially with advent of DSL).

Outside the context of distribution plant, Verizon conducts economic analyses to determine how much spare capacity should be built to serve likely future growth in demand. Tr. 4113-14 (Gansert) (describing calculation for feeder). Clearly, similar analyses should be undertaken with respect to distribution plant. Instead of doing such analyses, Verizon claims that "perfect omniscience" is not possible and that "neighborhoods demand changes over time." Verizon Exh. 122 (Verizon Recurring Cost Panel Surreb.) at 120-21. While it is always possible that demand could change significantly, that does not mean that it is efficient to construct spare capacity to provide for all possible increases even where such an increase is highly unlikely.

Even if the fill in Verizon's embedded network were taken as a starting point, however, the fill factor would have to be adjusted to account for the substantial number of defective pairs in its existing network – a number that would be far lower in a reconstructed network. In calculating its existing fill factor, Verizon divides working pairs by total pairs, including defective pairs. Verizon has acknowledged that **[BEGIN VERIZON PROPRIETARY]** **[END VERIZON PROPRIETARY]** of the pairs in its network are defective. AT&T/WCOM Exh. 12 (AT&T/WorldCom Recurring Cost Panel Reb.) at 63. But in a reconstructed network with new plant, there should be fewer than 1% defective pairs. *Id.* at 47; Tr. 3893 (Riolo).[140] Verizon does not dispute this. But this fact alone means that the distribution fill factor should be significantly higher than Verizon claims. Indeed, when the various factors set forth above are considered, the distribution fill factor of 60% proposed by AT&T and WorldCom in adjusting Verizon's studies is conservative – even if it were appropriate to build substantial spare capacity for future growth into the models and charge

[140] Contrary to Verizon's suggestions, a new network with fewer than 1% defective pairs is entirely realistic. Indeed, GTE's planning guidelines state that "Feeder facility non-repairable bad pair allowance will not exceed 2%-Urban and 3%-Rural for any working base fill) or project trigger calculation. Distribution facility non-repairable bad pair allowance will not exceed 1%." AT&T Ex. 117 at E1.

present customers for that capacity. AT&T/WCOM Exh. 12P (AT&T/WorldCom Recurring Cost Panel Reb.) at 45.

The biggest problem with Verizon's fill factor is its reliance on fill in its embedded network and its construction of distribution facilities to serve ultimate demand.[141] Tr. 2999-3000 (Tardiff). Verizon then calculates UNE prices as if current customers would pay for all of that spare capacity built to serve future demand.[142] Verizon contends that it is efficient to build to ultimate demand because of economies of scale associated with constructing all distribution plant at once. Verizon Exh. 122 (Verizon Recurring Cost Panel Surreb.) at 123-24. But even if this were so, that does not mean that present customers should pay now for all the distribution plant, AT&T/WCOM Exh. 12P (AT&T/WorldCom Recurring Cost Panel Reb.) at 45-46, or continue to pay for all the spare distribution plant as demand for that plant materializes. Charging present customers the full cost of spare capacity leads Verizon to overrecover its costs as demand for that plant materializes.

Consider, for example, the drop to the customer's location. In its embedded network, Verizon constructs two pairs to each location even if the customer only has ordered one pair. In its cost models, by applying a fill factor based on fill in the embedded network, Verizon charges the customer for the second pair even though the customer is not using the second pair. If the customer begins using that pair, Verizon does not provide the second pair for free but instead charges the customer the same price for the second pair as for the first pair, including the

---

[141] Verizon states that "distribution utilization is driven primarily by factors that are unrelated to growth. For example, . . . one of the primary determinants of distribution utilization is customers' current (or foreseeable) need for second lines." Verizon Exh. 122 (Verizon Recurring Cost Panel Surreb.) at 118-19. But constructing spare capacity to provide second lines is constructing spare capacity for growth – albeit growth of demand from customers already using one line.

[142] Because Verizon builds to ultimate demand, there is no need to build any additional plant as demand increases. Tr. 3000 (Tardiff); Tr. 4115 (Gansert). Instead, the utilization of the plant increases over time.

costs associated with application of a fill factor to the second pair. In effect, when the customer orders a second pair, Verizon charges the customer as if the customer needed four pairs. During cross-examination, Verizon's witnesses were unable to explain why the customers should have to pay anything for the second pair when the customer has been paying for that pair all along. Tr. 2932-38 (Tardiff, Shelanski).

As discussed above, a pure economic analysis would require constructing whatever spare capacity is efficient to provide for growth but charging customers based on expected demand. An approximation of this – although one that results in excessive charges – is to include little spare capacity for growth. *Cf. Universal Service Tenth Order* ¶ 199 ("the fill factors selected for use in the federal mechanism generally should reflect current demand and not reflect the industry practice of building distribution plant to meet 'ultimate' demand.") The fill factor for distribution resulting from such an analysis – in which customers were charged only for working pairs, pairs reserved for maintenance purposes and other pairs needed to operate the network today would be in the order of 90%. AT&T/WCOM Exh. 12 (AT&T/WorldCom Recurring Cost Panel Reb.) at 45-56. Verizon's fill factor is therefore far too low, and even the fill factor used by AT&T and WorldCom in their restatement is extremely conservative because it provides substantial spare capacity for growth.

In the Massachusetts 271 Order, the Commission questioned the appropriateness of Verizon's proposed 40% fill factor in the absence of a state-specific justification. It noted that higher fill factor had been adopted in the USF proceedings and by other state commissions.[143] Verizon has not provided a state-specific justification for such a low fill factor here.

[143] Memorandum Opinion and Order in Verizon Massachusetts Application for Section 271 Relief, CC Docket No. 01-9, FCC 0-130, rel. April 16, 2001 at ¶ 39.

c. Copper Feeder Utilization in the Synthesis Model

The Synthesis Model's target fill factors for copper feeder cable range from 70% to 82.5% and were selected by the Commisison in the USF proceeding. *Universal Service Tenth Order* ¶ 207. The effective fill factors will be lower after breakage is taken into account. This is extremely conservative. Verizon's own Engineering Guidelines require sufficient spare capacity to provide for three to five years of growth. Given that growth in Verizon's network has been averaging 3% per year, the fill factors in the Synthesis Model for copper feeder easily meet these Guidelines.

Verizon contends that the copper feeder fill factors in the Synthesis Model are insufficient to meet the requirements of its Engineering Guidelines, an argument the Commission rejected in the USF proceedings. *Id.* ¶ 207. Nonetheless, Verizon contends that these Guidelines require provision of 15% spare capacity for administrative and maintenance needs and additional spare capacity for three to five years of growth. Verizon Exh. 109 (Murphy Reb.) at 87. *But cf.* Verizon Exh. 122 (Verizon Recurring Cost Panel Surreb.) at 125-26 (describing need for an administrative spare of 9% to 15% of total capacity). Even if Verizon were correct that, on average, 15% spare capacity were needed for administrative purposes, and capacity for three years of growth at an average of 3% per year were provided on top of that, a fill of 76% would still be sufficient prior to breakage (70% with five years of growth). The fill factors in the Synthesis Model would therefore need little, if any, correction.

Moreover, Verizon is incorrect that an efficient carrier would provide 15% spare administrative capacity for copper feeder. According to GTE's planning guidelines, the relief triggers for feeder – the point at which the engineer begins considering providing relief for the feeder route – are typically well above 90%. AT&T Ex. 117 at E2-3. And even once the engineer begins considering providing relief to a route, this does not mean he will provide relief immediately. "In general, the engineer will not provide for provisioning of new facilities until close to the time when facilities will be exhausted." AT&T/WCOM Exh. 12P (AT&T/WorldCom Recurring Cost Panel Reb.) at 57.

Verizon argues that its Engineering Guidelines require an engineer to analyze non-interfaced plant when the feeder route will reach 85% fill within twelve months and also to "provide a solution" at that time. Verizon Exh. 122 (Verizon Recurring Cost Panel Surreb.) at 128. However, Verizon only quotes part of the Guidelines. While the Engineer must determine the solution when the feeder route has reached 85%, the solution does not have to be implemented until fill is near 100%. The Guidelines state that "Facility relief must be provided prior to the *critical exhaust date*." AT&T/WCOM Exh. 12P (AT&T/WorldCom Recurring Cost Panel Reb.) at 57 (quoting Outside Plant Engineering Guidelines, 1998-00397-OSP, (July 20, 1998) at 10. And the Guidelines define the critical exhaust date "as that point in time when the current facilities available can no longer support the service demand in a given route" – in other words, when fill approaches 100%. *Id.* Similarly, GTE's Guidelines state that "relief projects are to be scheduled to complete as near to existing facility exhaustion or customer need as possible in order to maximize facility inventory utilization." AT&T Ex. 117 at 6. Thus, there is no need for an administrative spare of 15% even under Verizon's Engineering Guidelines.

Nonetheless, as shown above, the copper feeder fill factors in the Synthesis Model provide spare capacity that is sufficient to allow for a substantial administrative spare and more than three years of growth. As a result, the Synthesis Model actually overstates Verizon's cost for providing copper feeder. The Model bases price on mid-year 2002 demand because that is the mid-point in demand over the three year planning period. The Model thus calculates prices based on growth in demand expected to materialize over three years. If spare capacity is built into the Model that accommodates more than three years of growth, as in fact has been done, but the costs of that capacity are not spread over the additional projected demand, Verizon will over-recover its costs.

d. Copper Feeder Utilization in Verizon's Model

Verizon's also understates utilization for copper feeder in its own models. **[BEGIN VERIZON PROPRIETARY]**

[END VERIZON PROPRIETARY] This is far too low. In Mr. Riolo's experience, it is conservative to assume an 80% utilization rate for copper feeder. AT&T/WCOM Exh. 12P (AT&T/WorldCom Recurring Cost Panel Reb.) at 62. Verizon's Mr. White stated that in his survey of 7% of the urban, suburban and rural feeder routes in Virginia the average feeder utilization was 80%. Tr. 4994-95, 5006-08 (White). Moreover, many of the unutilized pairs in Verizon's existing network are defective pairs. Verizon's data show that **BEGIN VERIZON PROPRIETARY *** *** END VERIZON PROPRIETARY** of the cable pairs in its network are defective. AT&T/WCOM Exh. 12P (AT&T/WorldCom Recurring Cost Panel Reb.) at 63. A reconstructed network would have fewer than 1% defective pairs, which would alone increase utilization substantially above that which exists in Verizon's embedded network. *Id.*

Certainly, an efficient forward-looking network -- even one built according to Verizon's own Engineering Guidelines -- would have utilization rates far above **[BEGIN VERIZON PROPRIETARY] [END VERIZON PROPRIETARY]** Verizon's Engineering Guidelines call for providing sufficient cable to allow for three to five years of growth. If a feeder route were relieved when utilization was 97% and five years of spare capacity were provided, the utilization of the route would be 82% immediately after relief for a route growing at the average growth rate in Verizon's network (3%).[144] *Id.* at 55-56, 58-59 & n. 48. The average utilization rate over the next five years would be 89.5%. A utilization rate of 80% is therefore conservative and allows sufficient capacity for growth, churn and breakage.

Moreover, as we have explained, an economic model should not provide spare capacity for growth without accounting for increased demand caused by that growth. Once again, Verizon provides spare capacity for growth but assesses costs as if no growth occurs.

e. Fiber Feeder Utilization in the Synthesis Model

The Synthesis Model uses a target fill factor of 100% for fiber strand. The Commission adopted this fill factor in its Model because fiber inherently contains spare that can be used for maintenance. Any growth in demand can be accommodated by changing the electronics on the end of the fiber without the need to add new fiber. *Universal Service Tenth Order ¶ 208;* Tr. 4497 (Riolo).

Verizon criticizes this fill factor. It claims that fiber is generally manufactured in 12-ribbon strands and that fewer than 12 ribbons are needed in each RT, resulting in a fill of less than 100 percent. Verizon Exh. 109 (Murphy Reb.) at 86-87. Verizon's criticism is based on the effects of breakage necessitated by limitations on the size of fiber ribbons. But the target fill factors in the Synthesis Model constitute the inputs into the Model *prior* to breakage. The effects of breakage are then calculated by the Model. Verizon's criticism is therefore entirely inapposite, as the 100% target for fiber fill is not intended to take into account the effects of breakage. The Synthesis Model itself accounts for the effect of the ribbon structure as discussed by Verizon.

[144] If three years of spare capacity were put in place when the network was initially constructed, the minimum utilization would be 91%.

f. Fiber Feeder Utilization in Verizon's Model

Verizon significantly understates the utilization for fiber feeder even within the constraints of its own models. Verizon states that utilization of fiber feeder is only 41.8% in its own network and that Verizon uses this percentage in its models. Verizon explains that the of fiber feeder utilization is low because the 12-fiber ribbon structure requires the provisioning of excess strands. Verizon Exh. 107 (Verizon Cost Panel Dir.) at 110-12.

In a forward-looking network, however, all "excess" fibers from use of 12-fiber ribbons would be used to provide other services. **[BEGIN VERIZON PROPRIETARY]**

[END VERIZON PROPRIETARY] An efficient carrier would use other fibers to provide high speed business services. AT&T/WCOM Exh. 12 (AT&T/WorldCom Recurring Cost Panel Reb.) at 53-54. The carrier would lease still other fibers to CLECs as dark fiber.[145]

In a forward-looking network, there would be little, if any, spare fiber. Indeed, Verizon has informed CLECs that it intends to use all spare fibers in its network – so that CLECs are now complaining about the unavailability of dark fiber. WorldCom Exh.121 at 214-217. Moreover, GTE's Infrastructure Provisioning Guidelines state that **BEGIN VERIZON PROPRIETARY**

END VERIZON PROPRIETARY. Verizon's fiber feeder utilization rate is therefore too low.

145 Verizon charges CLECs for unused fiber as part of the price of leasing UNEs for POTS services and then charges them again for that fiber if they lease dark fiber. Verizon cannot have it both ways.

g. RT Plug-In Utilization in the Synthesis Model

The FCC's Synthesis Model uses a single input for RT plug-in utilization, RT common equipment utilization, and copper feeder utilization. AT&T and WorldCom have not attempted to change that input, as the fill factors for RT plug-ins and common equipment are comparable to those proposed for copper feeder.

The Synthesis Model uses a fill factor for DLC equipment that is lower than necessary. The Model applies fill factors that range from 70 percent to 82.5 percent for RT plug-in utilization depending on the density zone. AT&T/WCOM Exh. 14 (Pitkin Surreb.) at 54. Given that Verizon itself claims that an 80% utilization level for plug-in equipment is appropriate, Verizon Exh. 109 (Murphy Reb.) at 90, Verizon has no basis for criticizing the plug-in utilization level in the Model.

h. RT Plug-In Utilization in Verizon's Model

Verizon's proposed plug-in utilization rate of 80% is itself too low. Unlike other fill factors proposed by Verizon, this rate is not based on plug-in utilization in Verizon's actual network, and the rate is inconsistent with Verizon's Engineering Guidelines. Thus, AT&T and WorldCom have modified that rate within Verizon's models to reflect a more accurate rate of 90%.

All parties agree that the plug-in channel units used with DLC are easy to install, requiring only a field visit, and that installation costs are very small relative to the cost of the plug-ins. AT&T/WCOM Exh. 12P (AT&T/WorldCom Recurring Cost Panel Reb.) at 64; Verizon Exh. 107 (Verizon Cost Panel Dir.) at 107-08. Therefore, in accordance with industry standards, Verizon's Engineering Guidelines state that spare capacity should cover only 6 months of projected growth. AT&T/WCOM Exh. 12P (AT&T/WorldCom Recurring Cost Panel Reb.) at 64. Based on Verizon's average growth rate of 3% a year, the utilization rate would therefore need to be 98.5% to provide for growth – and would be 98% in a 600 line unit even after breakage is taken into account. *Id.* at 64, 66; AT&T/WCOM Exh. 6 (Riolo Dir.) at 7-8, 37-38. Even if some additional plug-ins were left in place at recently vacated-premises, as Verizon posits, a utilization rate of 90% would easily be achievable on a forward-looking basis. AT&T/WCOM Exh. 12P (AT&T/WorldCom Recurring Cost Panel Reb.) at 65.

Verizon asserts that 10% spare capacity is needed as an administrative spare. Verizon Exh. 122 (Verizon Recurring Cost Panel Surreb.) at 135. This is simply not so. After spare capacity is provided for growth and recently-vacated facilities, no additional spare capacity is needed, and Verizon provides no reason for such spare capacity. GTE's own guidelines state that "[T]ypical relief trigger for DLC line cards and common equipment will be 95%." AT&T Ex. 117 at E3. Thus, 90% utilization is conservative.

i. RT Common Electronics Utilization in the Synthesis Model

As with RT plug-ins, Verizon incorrectly presumes that the Synthesis Model does not apply a fill factor to RT Common Electronics. Verizon Exh. 109 (Murphy Reb.) at 89. In reality, the Synthesis Model applies a very conservative target fill factor of 70% to 82.5%, depending on density zone. AT&T/WCOM Exh. 14P (Pitkin Surreb.) at 54. Verizon does not propose any alternative fill factor.

j. RT Common Electronics Utilization in Verizon's Model

In its own models, Verizon assumes a utilization rate of 56.9% for common electronics when an 80% figure would be more reasonable. In support of its proposed fill factor, Verizon does not rely on the utilization rate for common electronics in its embedded network but instead assumes that the utilization rate for common electronics will be the same as that for copper feeder.

Verizon's own Engineering Guidelines show that its proposed utilization rate for common electronics is far too low. Verizon claims that 10% capacity is needed for an administrative spare, along with an additional three years of spare capacity to provide for growth. Verizon Exh. 122 (Verizon Recurring Cost Panel Surreb.) at 138. Even at that level, utilization would be 81% in a typical RT immediately after new capacity is provided with some additional spare capacity to account for breakage (100% - 10% administrative spare - 9% for growth (9% = 3 years growth at an average of 3% per year)). Moreover, Verizon provides no explanation why any spare capacity is needed for administrative spare. GTE's own guidelines state that "[T]ypical relief trigger for DLC line cards and common equipment will be 95%." AT&T Ex. 117 at E3.

Verizon's contention that the fill factor for common electronics should be the same as that for copper feeder is unfounded. Unlike copper feeder, common electronics can be installed shortly before the capacity of the existing equipment is reached. AT&T/WCOM Exh. 12P (AT&T/WorldCom Recurring Cost Panel Reb.) at 67-68. *Cf.* Tr. 4502-04 (Gansert) (describing different characteristics of copper and fiber). Even if the utilization rates for copper feeder and common electronics were the same, Verizon would significantly understate the common electronics utilization rate because, as we have seen above, Verizon significantly understates its copper feeder utilization rate. Verizon bases its utilization rate on the copper feeder utilization rates in its existing network.

Verizon provides an example of what it calls "a *typical* size RT with 672 lines." Verizon Exh. 122 (Verizon Recurring Cost Panel Surreb.) at 139 (emphasis added). Once 605 of the lines (90% of 672) are in use, assuming a 10% administrative spare, a 224-line-relief shelf should be added, which would bring utilization down to 67.5%. But this means that even immediately after a relief job, this "typical" RT would have a utilization rate significantly above the **BEGIN VERIZON PROPRIETARY ***** ***** END VERIZON PROPRIETARY** proposed by Verizon. Moreover, even presuming that Verizon were correct that utilization would be 67.5% after relief, the utilization would increase over time due to growth in the network until it again reached 90%. Thus, the average utilization in the RT would be (90% + 67.5%)/2 or 78.75%.

Verizon's example also assumes a starting point that would not exist in a reconstructed network, as customers would not be grouped together in a DA in such a manner that an entire 224-line shelf in the DA would be entirely empty. Thus, Verizon's example of a "typical" RT actually shows that utilization rates should be far higher than proposed by Verizon.

Finally, it is important to note that utilization of common electronics would be far higher in a forward-looking network than in Verizon's embedded network. In Verizon's existing network, as it has grown over time, many customers are grouped into DAs that are now inefficient – and result in excessive breakage. Approximately 15% of the DAs in the Virginia service territory have fewer than 50 working lines, for example, which results in extremely low utilization rates in these DAs. AT&T/WCOM Exh. 12P (AT&T/WorldCom Recurring Cost Panel Reb.) at 17-18, 69-70.[146] In a reconstructed network, customers would be grouped to avoid such low utilization.

[146] Verizon's claim that the small DAs result from transmission limitations and efficiency concerns, Verizon Exh. 122 (Verizon Recurring Cost Panel Surreb.) at 73, is entirely unsupported. Verizon provides no indication that it looked at any of these DAs to determine why fewer than 50 customers were included. As for Verizon's argument that only a small percentage of the total working lines are in these DAs, Verizon Exh. 122 (Verizon Cost Panel Surreb.) at 72, fifty lines was an arbitrary cutoff in AT&T and WorldCom's analysis. There are likely many other DAs in Verizon's network with 60 lines or 70 lines – still far too small for an efficient grouping.